CLAIMS

What is claimed is:

1. A catalyst useful in a proton exchange membrane containing fuel cell for the electrooxidation of fuels prepared by the chemical activation of vapor deposited substantially semicrystalline PtX_aAl_b onto a substrate, wherein X is selected from the group consisting of Ru, Rh, Mo, W, V, Hf, Zr, Nb and Co, and a is at least 0.001, and b is at least 0.85• (1+a), with the proviso that when a=1 and b=8, X is only selected from the group consisting of W, V, Hf, Zr, Nb, and Co.

2. The catalyst of claim 1 wherein the fuel is an organic fuel and wherein

when X = Ru, a is at least 0.019, and b is at least 3• (1+a),

when X = Rh, a is at least 0.01, and b is at least 0.85• (1+a),

when X = W, a is at least 0.01, and b is at least 2.5• (1+a),

when X = V, a is at least 0.04, and b is at least 2.8• (1+a),

when X = Hf, a is at least 0.019, and b is at least 1.5• (1+a),

when X = Zr, a is at least 0.01, and b is at least 2.3• (1+a),

when X = Nb, a is at least 0.001, and b is at least 2.2• (1+a), and

when X = Co, a is at least 0.03, and b is at least 2.2• (1+a).

3. The catalyst of claim 1 wherein the fuel is methanol and the onset voltage for methanol electrooxidation is less than about 240 mV versus a saturated calomel electrode (SCE).

4. The catalyst of claim 2 wherein the organic fuel is methanol.

5. The catalyst of claim 1 wherein the fuel is hydrogen.

6. The catalyst of claim 1 wherein the substrate is selected from the group consisting of an ion exchange membrane and a gas diffusion backing.

7. The catalyst of claim 6 wherein the ion exchange membrane is the acid form of a perfluorinated sulfonic acid polymer.

8. The catalyst of claim 6 wherein the gas diffusion backing is carbon paper.

9. The catalyst of claim 8 wherein the gas diffusion backing further comprises a film of carbon particles and a fluoropolymer.

10. The catalyst of claim 9 wherein the fluoropolymer is PTFE.

11. A catalyst for an ion exchange membrane containing fuel cell comprising a ternary composition having an onset voltage for methanol electrooxidation of less than about 240 mV versus a saturated calomel electrode (SCE).

12. The catalyst of claim 11 wherein the terniary composition is prepared by the chemical activation of vapor deposited substantially semicrystalline PtX_aAl_b wherein X is selected from the group consisting of Ru, Rh, Mo, W, V, Hf, Zr, Nb and Co, and a is at least 0.001, and b is at least 0.85• (1+a), with the proviso that when a=1 and b=8, X is only selected from the group consisting of W, V, Hf, Zr, Nb, and Co.

13. A coated substrate comprising a substrate having applied thereon a catalyst composition, wherein the catalyst composition comprises a catalyst for the electrooxidation of fuels prepared by the chemical activation of vapor deposited substantially semicrystalline

$$PtX_aAl_b$$

wherein X is selected from the group consisting of Ru, W, V, Hf, Rh, Zr, Mo, Nb and Co, and

a is at least 0.001, and b is at least 0.85• (1+a); with the proviso that when a=1 and b=8, X is only selected from the group consisting of W, V, Hf, Zr, Nb, and Co.

14. The coated substrate of Claim 13 wherein the substrate is selected from the group consisting of an ion exchange membrane and a gas diffusion backing.

15. The coated substrate of Claim 14 wherein the ion exchange membrane is the acid form of a perfluorinated sulfonic acid polymer.

16. The coated substrate of Claim 14 wherein the gas diffusion backing is carbon paper.

17. The coated substrate of Claim 16 wherein the gas diffusion backing further comprises a film of carbon particles and a fluoropolymer.

18. The coated substrate of Claim 17 wherein the fluoropolymer is PTFE.

19. The coated substrate of claim 13 wherein the fuel is selected from the group consisting of an organic fuel and hydrogen.

20. The coated substrate of claim 19 wherein the organic fuel is methanol.

21. A fuel cell comprising a coated substrate, wherein the coated substrate comprises a substrate having applied thereon a catalyst composition, wherein the catalyst composition comprises a catalyst for the electrooxidation of fuels prepared by the chemical activation of vapor deposited substantially semicrystalline

$$PtX_aAl_b$$

wherein X is selected from the group consisting of Ru, W, V, Hf, Rh, Zr, Mo, Nb and Co, and

a is at least 0.001, and b is at least 0.85• (1+a); with the proviso that when a=1 and b=8, X is only selected from the group consisting of W, V, Hf, Zr, Nb, and Co.

22.The fuel cell of Claim 21 wherein the substrate is selected from the group consisting of an ion exchange membrane and a gas diffusion backing.

23.The fuel cell of Claim 22 wherein the ion exchange membrane is the acid form of the perfluorinated sulfonic acid polymer.

24.The fuel cell of Claim 22 wherein the gas diffusion backing is carbon paper.

25. The fuel cell of Claim 22 wherein the gas diffusion backing further comprises a film of carbon particles and a fluoropolymer.

26. The coated substrate of Claim 25 wherein the fluoropolymer is PTFE.